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ECCOMAGS: Initial results from the RESUME 2002 exercise

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Abstract

In the RESUME 2002 exercise (Rapid Environmental Surveying Using Mobile Equipment) areas in SW Scotland were surveyed for anthropogenic and natural radioactivity with Airborne Gamma Spectrometry (AGS), Car-borne Gamma Spectrometry (CGS) and in-situ measurements. Results from the exercise are presented, including composite maps and data produced at the exercise, and initial results from the post-exercise data analysis. A format for processed data exchange developed for the exercise is presented. The final data analysis will include comparisons within airborne and between airborne and ground based measurements.

Key words

Aerial Monitoring; Cesium 137; Data Analysis; Data Processing; Dose Rates; Gamma Spectroscopy; Radiation Monitoring

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1. Introduction

As part of the European ECCOMAGS project (European Calibration and Coordination of Mobile and Airborne Gamma Spectrometry) the RESUME 2002 exercise was held between 24th May and 4th June 2002 in Dumfries and Galloway Region, SW Scotland. The primary aim of the exercise was to evaluate the ability of Airborne Gamma Spectrometry (AGS) teams in Europe to produce consistent dose rate and radionuclide deposition data using predefined protocols and to demonstrate mapping capabilities following a nuclear fallout. Ten AGS teams, three Car-borne Gamma Spectrometry (CGS) teams, and seven teams performing in-situ and dose rate measurements took part in the exercise. In addition, soil cores were collected from 39 locations within the exercise area for laboratory measurements of the radionuclide depth profiles. Teams and institutions participating in the exercise are listed in Table 1.

Survey tasks included measurements at calibration sites and surveys of common areas to enable direct inter-comparisons between airborne systems and comparison with ground-based measurements. The work also included a composite mapping task where each team was asked to measure part of a very large area. The combination of the results from many teams demonstrated speed of data capture, and the abilities of teams from diverse countries to cooperate effectively in a nuclear emergency.

A Design and Evaluation Group (DEG) was formed to carry out tasks of planning the exercise and performing the post-exercise data processing and analysis. The planning phase included conducting a pre-characterization study of the survey area (1,2), and finalizing measurement protocols for the use of airborne gamma spectrometry to estimate ground level environmental gamma dose rates and deposited activity on the ground, developed under the 4th European Framework Programme (3). An important objective of the RESUME 2002 exercise was to validate these protocols in order to develop them as European standards for AGS following a nuclear emergency. The flight tasks and ground based sampling plans were formulated with these aims in mind (4,5). Shortly after the exercise initial data inter-comparisons and composite mapping results were reported (6,7). DEG is currently completing detailed statistical analyses of measurement data received during and after the exercise, to be used together with individual team reports in preparation of the European exercise final report.

NKS has an important role in initiating intercomparison of AGS systems through the RESUME95 exercise (8,9). It is also providing support to the ECCOMAGS project through participation in the DEG. This participation has focused on developing a format for data management and exchange and on the post-exercise data analysis and comparisons.

In the present report, initial data mapping and comparisons performed during the exercise are summarized. The comparative analysis undertaken by the DEG is described and initial results of this work are presented. The format for data management and exchange (the extended NKS format) has been adapted from the data format developed for the RESUME-99 exercise (10), and is here described in detail.

Table 1: AGS and/or ground-based teams involved in the RESUME 2002 exercise

Team	Organisation	Form of participation
BfS	Bundesamt für Strahlenschutz, Fachbereich Strahlenschutz, Berlin, Germany	2 AGS teams, 1 ground-based team
BGS	British Geological Survey, Keyworth, Nottingham, UK	1 ground-based team
CEA	Commissariat a l'Ėnergie Atomique, CEA / DAM - Ile de France, Bruyeres-le-Chatal, France	1 AGS team 1 ground based team
DSTL	Defence Science Technology Laboratory DSTL Radiation Protection Services, Gosport, UK	1 ground-based team
ERC	Environmental Research & Consultancy University of Liverpool, Wirral, UK	1 ground-based team
SSI	Swedish Radiation Protection Authority, Department of Environmental Monitoring and Dosimetry, Stockholm, Sweden	1 AGS team 1 CGS team 1 ground-based team
SGU	Geological Survey of Sweden, Uppsala, Sweden	1 AGS fixed wing team
DEMA / DTU	Danish Emergency Management Agency, Nuclear Safety Division, Birkerød, Denmark & Technical University of Denmark, Lyngby, Denmark	1 AGS team 1 CGS team
GBA	Geologische Bundesanstalt, Department of Geophysics, Vienna, Austria	1 AGS team
HSK	Swiss Federal Nuclear Safety Inspectorate, Hauptabteilung fuer die Sicherheit der Kernanlagen, Villigen, Switzerland	1 AGS team
IGM	Geological Survey of Portugal, Divisao de Geofisica, Zambujal, Amadora, Portugal	1 CGS team
MORAL- AUS	ARC Seibersdorf Research, Division Health Physics / Radiation Protection, Seibersdorf, Austria	1 European in situ team
MORAL-Czech Rep	National Radiation Protection Institute Srobarova , Prague, Czech Rep	1 European in situ team
MORAL-LFU	Landesanstalt fur Umweltsschutz Baden-Württemberg, Hertzstrasse, Karlsruhe, Germany	1 European in situ team
MORAL-NLÖ	Niedersächsisches Landesamt für Ökologie Göttinger Straße 14, D-30449 Hannover, Germany	1 European in situ team
NOR	Headquarters Defence, Command North Norway, Bodø, Norway	1 AGS team
Stir-Uni	Department of Environmental Sciences University of Stirling, Stirling, UK	1 ground-based team
SURRC	Scottish Universities Research and Reactor Centre, Scottish Enterprise Technology Park, East Kilbride, UK	1 AGS team

2. Data mapping and comparisons performed during the exercise

Data recorded during the exercise comprise raw data, processed data and maps produced by each team. Questionnaires were issued to each team, in order to gather information on system instrumentation and data processing procedures. Based on these questionnaires the instrumentation of the AGS and CGS teams is summarized in Table 2.

Table 2. Survey specification and instrumentation

Team	Platform	Speed (km h^{-1})	Survey height (m)	Altimetry system	System name	Detector	Sampling time	Detector position
BFS	helicopter	110	60	yes	BFSA, BFSB	12 l NaI(Tl)	2 s	inside aircraft
					BFSG	50% HPGe	60 s	inside aircraft
CEA	helicopter	60	60	yes	CEAA	16 l NaI(Tl)	2 s	below aircraft
					CEAG	2x70% HPGe	2 s	below aircraft
DEMA	helicopter	150	60	no	DEMAA	16 l NaI(Tl)	1 s	inside aircraft
HSK	helicopter	110	100	yes	HSK	16.8 l NaI(Tl)	1 s	inside aircraft
SGU	fixed wing	240	100	yes	SGU	16.4 l NaI(Tl)	1 s	inside aircraft
SSI	helicopter	150 - 170	60	no	SSIA	4 l NaI(Tl)	2 s	inside aircraft
					SSIG	70% HPGe	10 s	inside aircraft
SURRC	helicopter	110 - 150	100	yes	SURRCA	16 l NaI(Tl)	2 s	inside aircraft
					SURRCG	50% HPGe	4 s	inside aircraft
DEMA	car	40 - 50	2.2	n.a.	DEMAC	4 l NaI(Tl)	2 s	on roof, right
IGM	car	40	2	n.a.	IGM	4 l NaI(Tl)	1 s	on roof, right
SSI	car	50	2.1	n.a.	SSIC	4 l NaI(Tl)	5 s	on roof, center

The areas surveyed are shown in Fig. 1. AGS monitoring was performed at three calibration sites: Castle Kennedy, Inch Farm and Wigtown Merse, and at three designated (common) areas labeled X, Y and Z. In addition, to examine the capability of European monitoring teams to survey a large area following a nuclear emergency a composite map was produced from AGS data recorded in 9 contiguous areas, A-I.

In Figs. 2-4, the initial results obtained immediately after the exercise are reproduced from Ref. (6) and the project web-site, **http://www.gla.ac.uk/ECCOMAGS**. In Fig. 2, the dose rate and ^{137}Cs deposition at the Inch Farm calibration site are shown. The agreement between ^{137}Cs deposition data is better than for dose rate, as several teams used the Inch Farm pre-characterization study to calibrate measurements of ^{137}Cs activity, while most teams used prior calibration for dose rate. Scaling factors were derived from the Inch Farm calibration site and used to level all data used in producing the composite maps, Figs. 3-4. In Fig. 3, discharges of ^{137}Cs from the Sellafield Reprocessing Plant can be seen to cause elevated levels in the marshes south of Newton Stuart and Dalbeattle.

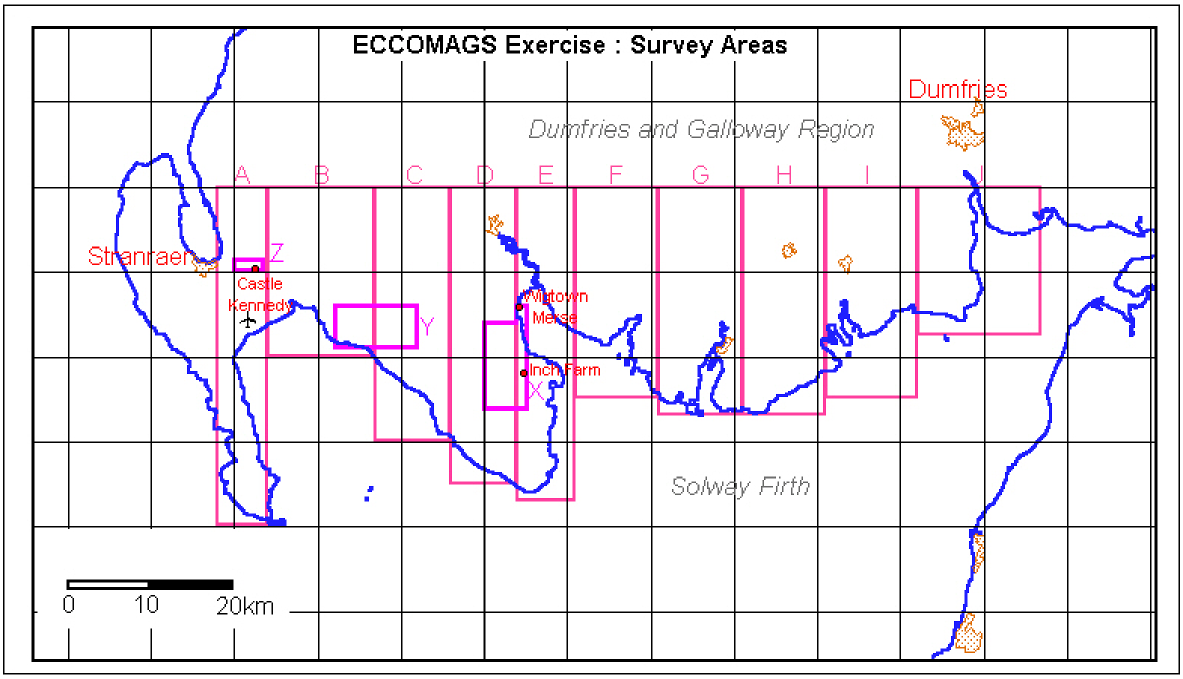

Figure 1. Survey areas of the RESUME 2002 exercise, comprising common areas (X, Y, Z), calibration points (Castle Kennedy, Inch Farm and Wigtown Merse) and contiguous survey areas (A – I).

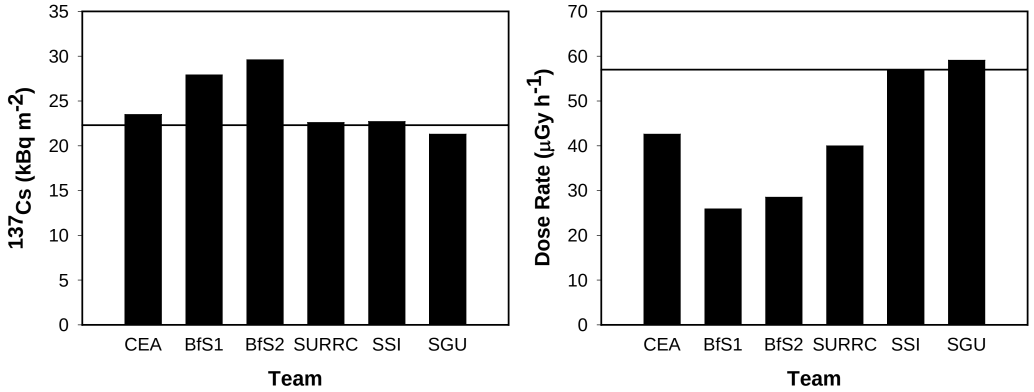

Figure 2. ^{137}Cs deposition and dose rate results for the Inch Farm calibration site. Results from the Inch Farm pre-characterization study (1) are shown as horizontal lines.

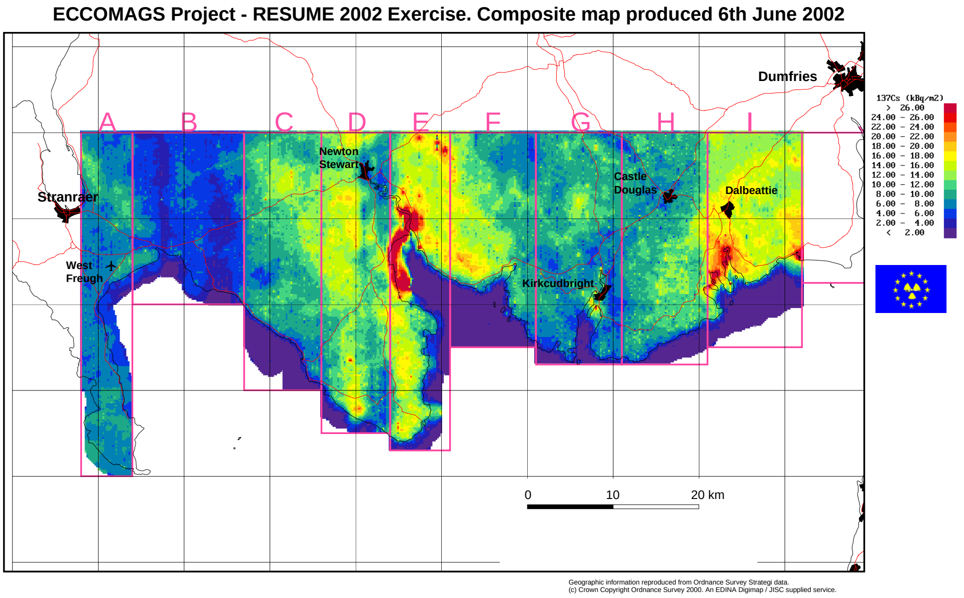

Figure 3. Composite (leveled) map of ^{137}Cs deposition produced on June 6th, 2002.

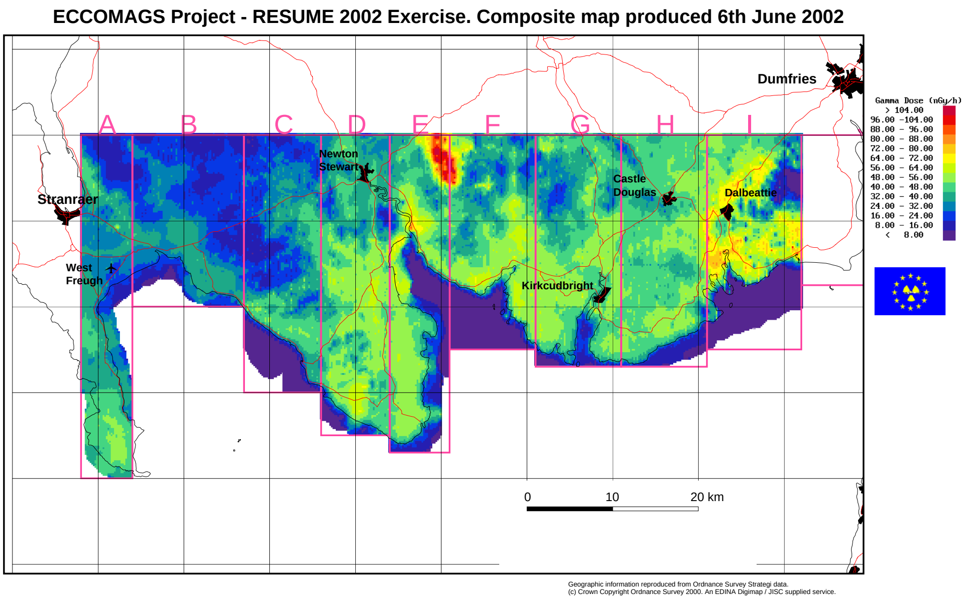

Figure 4. Composite (leveled) map of dose rate produced on June 6th, 2002..

3. Post-exercise data analysis

The data analysis and comparisons undertaken by DEG include descriptions of methods and of data collected during the exercise, comparison within AGS methods and results, and between AGS and ground based results. Comparison of methods and data is based in part on descriptions provided by each team, and in part by statistical analysis of the processed data submitted by the teams. The statistical data analysis is based on measurements at the calibration sites and the common areas. In Table 3, processed ^{137}Cs deposition and dose rate data reported by the AGS teams have been summarized. Presently, only one team (SSI) has reported HPGe-data, cf. Table 2.

To allow for quantitative comparison within AGS measurements on the common areas X-Z, results for these areas have been regridded. In this procedure, interpolated data sets on a regular grid are determined as weighted means over nearby survey positions. As more data points are included in each mean, the short-range spatial variation of the gamma field (dose rate or deposited activity) is suppressed, while on the other hand, the statistical noise associated with individual measurements is also reduced.

To examine different algorithms for regridding, a set of weight functions $f(r; p, \Gamma, R)$ have been employed,

$$f(r) = \begin{cases} \dfrac{1}{r^p + \Gamma^p}, & r < R \\ 0, & r > R \end{cases}$$

Fig. 5 depicts these functions for R = 500m, p = 1, 1.5 and 2, and Γ = 50m, 75m and 100m, respectively, and in Fig. 6 the corresponding regridded maps of ^{137}Cs deposition in area X are shown. The data used for producing the maps are from the SURRC AGS team using their NaI detector system. From the figure, it is seen that as either Γ decreases or p increases the pixel-to-pixel variability increases.

Table 3. Reported AGS processed data

System	Calibration points			Common areas			Data format*)	Common area maps	
	CK	IF	WG	X	Y	Z		^{137}Cs	dose rate
BFSA	X**	X		X	X	X	prd	X	
BFSB	X**	X	X**	X	X	X	prd	X	
CEAA	X	X	X	X	X	X	xls	X	
DEMAA	X	X	X	X	X	X	prd		X
SGU	X	X	X	X	X	X	prd		
SSIA	X	X	X	X	X	X	nks		
SSIG	X	X		X	X	X	nks		
SURRC	X	X	X	X	X	X	prd	X	X

*) nks: original NKS format
prd: extended NKS format
xls: Microsoft Excel format

**) Only ^{137}Cs data provided

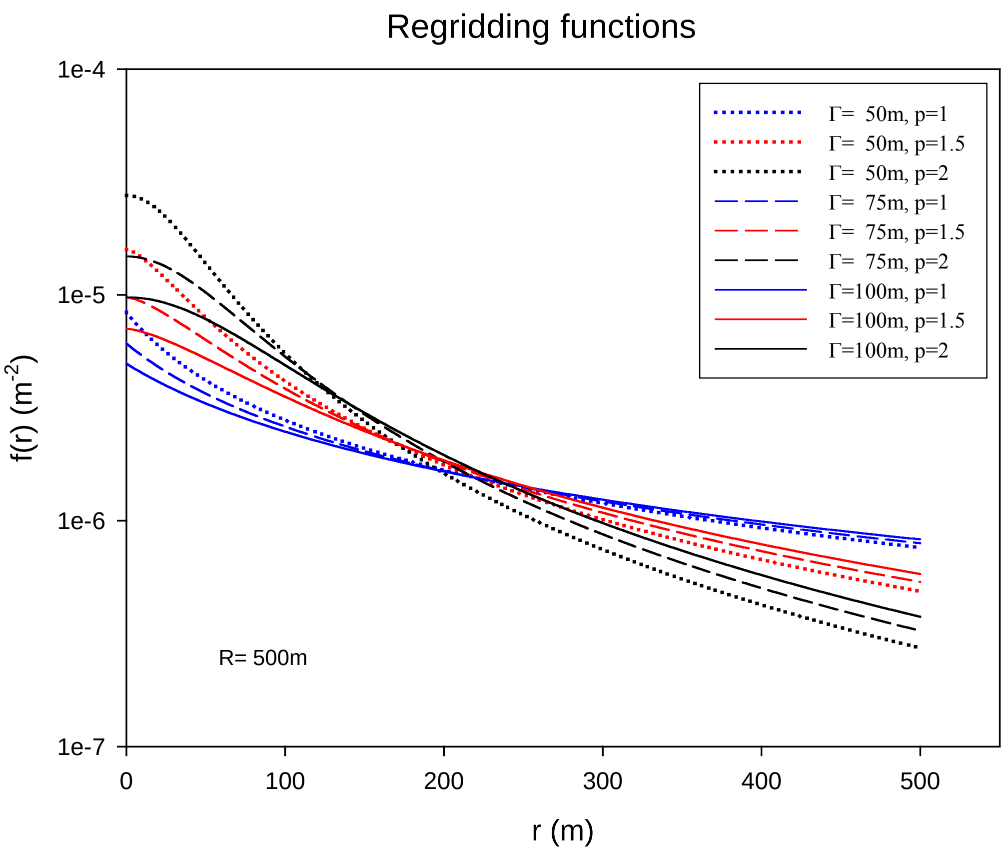

Figure 5. Weight functions f(r; p, Γ, R) used for regridding maps as shown in Fig. 6. Weight functions have been normalized to have unit surface integral, $\int d^2r \; f(r) = 1$.

As an example of the statistical data analysis undertaken by DEG, the cumulative ^{137}Cs activity distribution of area X is shown in Fig. 7. The data set consists of deposited activity of ^{137}Cs recorded along the actual flight lines (unleveled data). The figure shows the different systems to record similar activity distributions; the different data sets are slightly shifted in value but have similar coefficients of variation. Only the single HPGe system (SSI-Ge) displays a larger dispersion of ^{137}Cs activities, as indicated by the smaller slope of its distribution function vs. activity concentration.

The regridded maps are used for detailed investigation of the similarities and differences between teams. To account for a simple difference in calibration, maps are leveled to yield the same value of dose rate or ^{137}Cs deposition at the Inch Farm calibration site. In Fig. 8, regridded and leveled SURRC AGS data for area X are compared to a reference value defined as the mean value over all teams. In this example, the scatter plot shows a strong correlation between SURRC data set and the reference data set (r^2=0.87), with the linear regression of the two data sets having close to unit slope (b=1.07).

A comprehensive statistical analysis of the data recorded during the exercise will be published in the ECCOMAGS Final Exercise Report.

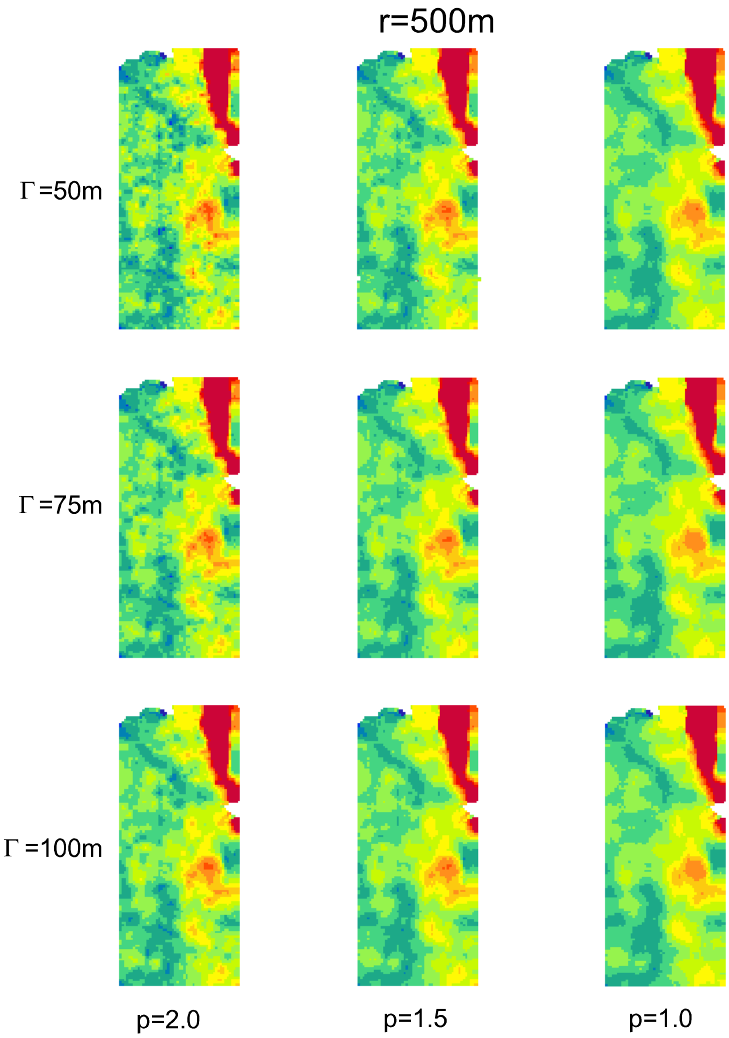

Figure 6. Regridded ^{137}Cs deposition maps of area X produced using different algorithms (see text). Data from the SURRC AGS team.

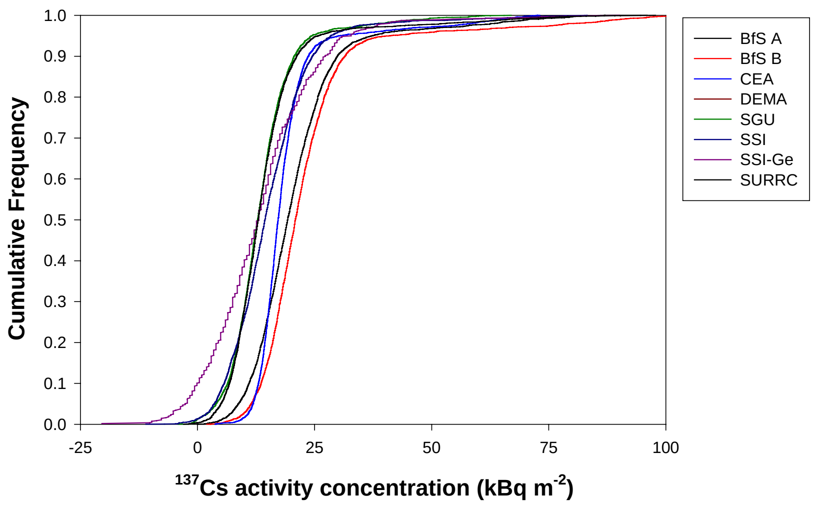

Figure 7. Cumulative ^{137}Cs activity distribution of area X.

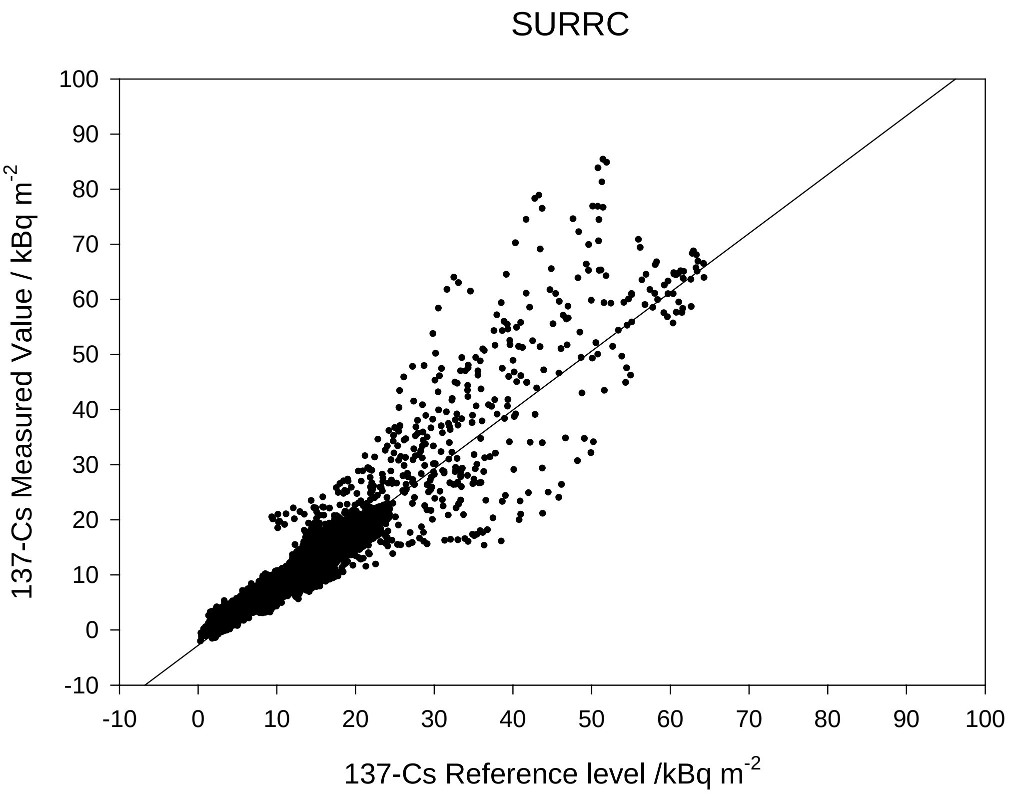

Figure 8. Regression analysis of regridded area X data: SURRC vs. reference value.

4. Processed data exchange format

A file format for storing and exchanging radiation measurement data in a general form was developed for the RESUME 2002 exercise. The data format is presented in detail in the appendix. The format is built on the original idea of the Nordic Safety Research NKS format as defined in 1999 for reporting mobile radiation measurement data. Here, the 1999 version has been substantially modified and expanded with the intention to make it more generally applicable. The format is still primarily designed for mobile measurements but can also be applied to *in situ* radiation measurements and measurements on samples. It is solely based on entities consisting of identifier-value pairs describing the quantities and measured values. The format has a simple structure and is readable by humans.

Based on the original idea of the NKS format, the following requirements for an improved and expanded format were defined:

1. The format should be suitable for mobile radiation measurements.
2. It should use ASCII characters and be readable by humans.
3. It should allow extensions.
4. It should be convertible to other commonly used formats when applicable.
5. It should be possible to expand the format to other types of radiation measurements, although this might not be the optimum solution for reporting data.
6. Partly corrupted data should not prevent conversion software from correctly reading remaining data.
7. Efforts should be made to keep the file space needed for description of the data as small as practically possible, taking readability by humans into account.

File names of the NKS 1999 version had the extension NKS. In order not to confuse the new data format with the NKS 1999 format data files with the new format has the extension PRD (multiple Paired Radiation Data format).

The PRD format was tested for the first time in the RESUME 2002 exercise. Processed data from airborne and car borne gamma spectrometry surveys was delivered to the exercise leaders for map production and comparative analyses. Most teams used the format as it is described here while a few teams used the old NKS format or Excel sheets. No investigation was made after the exercise whether the participants in the exercise were satisfied with the format. Therefore it cannot be excluded that the present version contains inconsistencies or limitations and may need additional modifications and extensions. Furthermore, the Resume 2002 exercise only proved to be a limited test of the format since the only measurable radioactive contents in the ground except for natural nuclides was low to medium levels of Cs-137. For a more complete evaluation of the format it should be tested in several different radiological situations and for different types of measurement systems. For full use of the format in the future a program should be developed for compliance tests with own data series and also an interface for adding or extracting individual data records. Finally a program for translation between some of the more common data formats is needed.

5. Conclusions

The RESUME 2002 exercise for AGS and ground-based measurements was held in May/June 2002 in SW Scotland. 24 teams from 10 countries took part in the exercise. Large data sets, comprising raw data, processed data and maps, were generated in the exercise and are currently being analyzed by the ECCOMAGS Design and Evaluation Group (DEG). The main aim of the exercise and the data analysis is to validate draft protocols for AGS dose rate and deposition mapping of environmental radioactivity.

The RESUME 2002 exercise is the first European scale benchmark exercise for AGS. Initial results demonstrate the ability of European AGS teams to produce comparable results in almost real time, and the ability to cooperate for nuclear emergency response to produce composite deposition and dose rate maps of large survey areas. The Cs-137 deposition examined in the exercise included a range of activity levels, and the data base generated from the measurements can be used for further investigation of data processing and mapping techniques. Measurements protocols developed within the ECCOMAGS project are expected in the future to contribute towards developing European standards for dose rate and radionuclide deposition mapping.

NKS has been a partner in this project by providing support to the DEG, cooperating with the EU ECCOMAGS on developing a format for data management and exchange and the post-exercise data analysis.

Acknowledgements

The financial support for the ECCOMAGS project from the European Commission under contract FIKR-CT-2000-20098 is gratefully acknowledged, as is the UK support for the exercise coordinated by the SNIFFER organization. We are also pleased to acknowledge the very significant contributions made by all the AGS participants and ground based teams listed in table 1 of this report.

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APPENDIX

The multiple-paired radiation data format for storing and exchanging data from mobile and fixed radiation measurement units

Version 0.9, February 19, 2002

Format rules

An identifier must always be followed by a value. Space is separator between identifiers and values. Any number of identifier and value pairs can be written on a row. If there is no obvious value, then a dummy value must be given to preserve the format rule. The only exception to this rule is the comment markers.

Comments

The method of marking comments with a slash and a star is kept the same as in the NKS 1999 format. The combination /* marks the beginning of a comment. The end of a comment is marked by */. In case there is no end of comment mark, the end of the record should be taken as end of comment. Comments cannot continue to the next record without a new begin of comment mark /*.

The order of identifiers

The original principle of the NKS 1999 format allowed the identifier-value entities to be given in any order. In the expanded format this principle cannot be fulfilled.

Some identifiers are valid for a subset of measurement data. For example, the measurement date and time having the identifiers CD and CT are valid for a specific set of results. Such identifier-value entities should be placed in the same record (row). This would make records containing sets of measured data look the same and would make it easier to manually read or transfer data, for example, to a spreadsheet utility.

A value belonging to a specific identifier is valid for all data that follows until the next occurrence of the same identifier. Since the measured quantities dose and activity always will be related to a specific time, place and geometry, the time, place and geometry identifier-value pairs should be placed before the measured values of dose and activity.

Case sensitivity

When reading the format there should be no case sensitivity for identifiers. When writing the format it is recommended to use capital letters for the identifiers except for the radionuclide tails that should be written according to the rule Xx-000m. Values are case sensitive.

Values containing spaces

Values can be numeric, alphanumeric or a string of text. Since space shall be interpreted as separator, a string of text that contains spaces must be given within double quotes to show that the string should be treated as a single value and not a combination of identifiers and values. For example "This text is a valid value".

Units

Numeric values will often have a unit. The units are predefined in this version of the format. They are given in the definition table of the format. Activity units are combinations of Bq, m and kg, for example Bq/m^2 and Bq/kg. Dose rate units are combinations of µSv, µGv and h, for example µSv/h. All length units are in metres, except for precipitation rate that is given in mm/h.

The identifier groups

The first character of the identifier is specific for the group of quantities that it represents. For example, all quantities that are related to dose will start with the letter D. The second letter identifies the main "branch" in the group of the quantities. For example DE symbolises equivalent dose of different types and DH symbolises the measurable dose equivalent quantities. The third (and forth and fifth etc) letter specifies the quantities more precisely. For example DHS symbolises ambient dose equivalent H*(10) and DHSR symbolises ambient dose equivalent rate. Frequently used identifiers are defined to be as short as possible.

The following groups of identifiers are defined:

A Activity and activity concentration
C Calendar date and time
D Dose and dose rate
F Fluence and fluence rate
H Heading with general information
I Heading with description of instrumentation, carrier and method
N Record number or other identification of a record
P Location of measurement
Q Location of source
S Source description, geometry, type and treatment
T Acquisition time
U Measuring units (not yet implemented)
V File format version
W Weather and environmental data
Raw data, counts and count rate
/* Comments
& Additional identifier recognition

The identifier tails

Uncertainty and detection limit tails (Type 1)

The underscore character is reserved to mark specific tails of identifiers symbolising specific qualities such as detection limit, _LD, random uncertainty, _UR, estimated value, _G etc. All identifiers representing dose, D, and activity, A, can have these tails.

The following identifier tails of Type 1 are defined:

_L Limit
_U Uncertainty
_A Apparent
_G Estimated

Example:
Detection limit for kerma rate: DKR_LD
Random uncertainty of activity per unit area AA_UR
Apparent activity of point source AP_A
Estimated activity per unit volume AV_G

Sometimes it is necessary to identify that a value is an estimate (a guess) and not measured. The tail, _G, is used to mark estimates. It can be used to mark that a source geometry is a guess rather than a measured value. Adding a tail, _G, at the end of the source geometry identifier can mark such a guess. For example SGA_G 0 would indicate that the radionuclide is assumed distributed as an infinite plane source at the surface of the ground (depth 0 metres).

The tail _A is used to mark apparent values. Apparent values are measured quantities depending on an estimate or a guess of some important parameters. For example, when the *in situ* source geometry is guessed the measured activity will be an apparent value. In the above example assuming that the activity is distributed on an infinite plane surface on the ground, SGA_G 0, then the activity identifier, AA, can be marked with the tail, _A, showing that AA_A it is the apparent activity per unit area assuming the specific source geometry.

Radionuclide tails (Type 2)

There is also a need to expand the format to include possible radionuclides. The solution using tails is also chosen here. The radionuclide is formed by listing the two-character element symbol from the periodic table followed by a dash (-) and then the mass number. An m may be placed at the end to designate a metastable state.

The following identifier tails of Type 2 are defined:

_Xx-000m	Radionuclide
_E	Energy

Example:
AA_Tc-99m identifies the activity per unit area of the radionuclide Tc-99m.

Tails of Type 1, symbolising detection limit and uncertainty can be combined with radionuclide tails of Type 2. Type 2 tails should be written last.

Example:
AA_LD_Tc-99m symbolises the detection limit in the activity per unit area for Tc-99m.

Since all radionuclides are allowed as tails starting with an underscore, a conversion program must be properly programmed to recognise Type 1 and Type 2 tails. For example, the tail _U that symbolises uncertainty and the radionuclide tail _U-238 will both begin with the letter U, but the radionuclide tail can be recognised by the presence of the dash followed by a number. A conversion program has to check this.

Tail Type 1 should precede tail Type 2. Some identifiers can take on a parenthesis with a system identifier (*sysid*). The (*sysid*) should always be placed last in the identifier after all tails. There should be no space before the (*sysid*).

Example:
AA_Tc-99m_LD is wrong, AA_LD_Tc-99m is correct.
With the system identifier (1) this would be written AA_LD_Tc-99m(1).

Description of the identifiers

V group - version identifier

There is a need to identify the version of the format, because the format is open and can be extended. The version described here is preliminary and should be assigned the value 0.9. The V identifier should be given in the first record.

H group of identifiers for header data

Some of the identifiers are generally valid for a whole set of measured data. For example, organisation, operational mode and team codes are valid for all data in the file. These identifier-values should be written before the set of measurement data. For visual clarity it is recommended to mark them as a "header" by enclosing them within comment lines. Although the format allows header data to be placed anywhere in the file, it is good practice to put header information in the beginning of the file. Example:

```
/* Begin of header */
V 0.9
HORG SURRC HMODE R HTEAM Alpha HSITE "Loch Ness" HFILE UKA0001.RAD
/* End of header */
```

Some organisations could use the format for electronic reporting into a national database. In this case there is a need to separate exercise data from real data. The identifier, HMODE, for operational mode is used for this purpose. Values are REAL, EXERCISE or TRAINING.

I group of identifiers for system and method identification

The NKS 1999 format had defined only one identifier SYS for the description of the instrumentation and measuring system. Systems, however, could have more than one instrument. For example, in a car or a helicopter, dose rates could be measured both with a dose rate instrument and a spectrometer. When using spectrometry to measure the primary fluence rate to obtain the dose rate, the geometry of the source must be stated since the scattered radiation component is not measured but obtained from theory where specific source geometry is assumed. If the results from different methods are reported together there should be a way to identify which system and method that has produced each result. Declaring the instrument, carrier and method to belong to a specific subsystem does this. Placing a parenthesis containing the subsystem identification as the last part of the identifier does the declaration of subsystems. Subsystem identifications could be numbers, although alphanumeric strings are also allowed. The I-identifier group is designed for these declarations.

Example: The instrument, carrier and measuring geometry for a sodium iodide spectrometer and a GM-tube dose rate instrument in a helicopter could be declared as:

```
/* Begin of instrumentation definitions */
IAP(1) "GR660"  ICA(1) "Bell 412" IMF(1) "spectrometer in centre of helicopter"
IA1(2) "RNI10S" ICA(2) "Bell 412" IMF(2) "GM-probe outside on starboard side"
IA1(3) "RNI10S" ICA(3) "Bell 412" IMF(3) "data recalculated to 1 m above ground"
/* End of instrumentation definitions */
```

It is good practice to put the instrumentation declaration in the first part of the file together with the "header" declarations. For clarity each subsystem should be declared in a record of its own.

The records in the main body of the file will contain measured data. These data could refer to the declared subsystem identification by placing a parenthesis with the subsystem identification at the end of the identifier. For example, part of a record reporting dose rate and activity could look like this:

/* Begin of measurement data reporting */

DHSR_Cs-137(1) 0.01 DHSR(1) 0.06 DHSR(2) 0.05 DHSR(3) 0.15 AW_K-40(1) 550

This example uses the identifiers

DHSR_Cs-137(1)	the ambient dose equivalent rate for Cs-137 measured by the spectrometer in the helicopter,
DHSR(1)	the total ambient dose equivalent measured by the spectrometer in the helicopter,
DHSR(2)	the total ambient dose equivalent rate measured by the GM-probe outside the helicopter,
DHSR(3)	the above quantity recalculated to 1 m above ground
AW_K-40(1)	the activity of K-40 per unit mass of the ground.

In the case of only one subsystem the parenthesis in the declaration of instruments, carrier and method is not needed.

C group of identifiers for calendar date and time

Date and time of day is written according to the International Standard ISO 8601. This means that dates should be given as YYYY-MM-DD, for example 2002-04-08, which means April 8, 2002. Time of day is given as hh:mm:ss, for example 18:34:20, which means 34 minutes and 20 seconds past six o'clock in the afternoon.

Without any further additions, a date and time as written above is assumed to be in the local time zone. In order to indicate that a time is measured in Universal Time (UTC), a capital letter Z can be appended to the time as in 18:34:20Z. The Z stands for the "zero meridian", which goes through Greenwich in London.

To indicate local time the string +hh can be used to indicate that local time zone is hh hours ahead of UTC. For time zones west of the zero meridian, which are behind UTC the notation -hh can be added to the value of the local time. For example, Central European Time (CET) is +01 and U.S./Canadian Eastern Standard Time (EST) is -05. The following strings all indicate the same point of time:

12:00:00Z = 13:00:00+01 = 07:00:00-05

A group of identifiers - activity

The A-group of identifiers contains different activity quantities such as activity per unit area, AA, activity per unit volume, AV, activity per unit wet weight, AW, and activity per unit dry weight, AD. There is also an identifier for equivalent surface deposition measured at 1 m, AE, and at another specific measurement height above ground, AF, where the height above ground is given by the location identifier PH.

Activity is always related to a radionuclide. This is identified by adding a tail of Type 2 with the radionuclide symbol to the main body of the identifier. All possible radionuclides are allowed as tails to the activity identifiers.

Example:
The activity per unit volume of Tc-99m will have the identifier AV_Tc-99m.

D group of identifiers - dose and dose rate

The D group contains many identifiers describing different dose and dose rate quantities as defined by ICRU. There is for example dose to air in free air, DA, air kerma free in air, DK and ambient dos equivalent, DHS. Placing the letter R at the end, for example, ambient dose equivalent rate, DHSR, identifies rate.

N identifier - record number

Running numbers of records can be denoted by using the identifier N. The N-identifier has no branches. In the 1999 version of the NKS format the identifier REC was used for the same purpose.

P group of identifiers - position (location) of measurement

In the 1999 version of the NKS format there were identifiers for the north-south coordinate and the east-west coordinate of the measurement point. The identifiers included the map datum had 7 characters, which required some space when repeated many times in a file. In this extended version the definition of map datum is separated from the location coordinate identifier. The map datum is identified by using the IP*mapdatum* identifier, where *mapdatum* is for example WGS84 or BNG. It should be placed in the heading section of the file.

Example:
Using the GPS navigator Garmin 12 XL to produce WGS84 coordinates is written
IPWGS84 "Garmin 12 XL"

After defining the map datum the identifier PN is used for the north-south coordinate and PE for the east-west coordinate. The use of X and Y has not been chosen here because it could lead to confusion. In some geographic coordinate systems the X coordinate is equal to the north-south direction, not the east-west direction. The altitude above sea level, PZ, and ground clearance, PH, can also be given. The units for altitude and ground clearance are metres.

When measuring the dose rate from point sources, the direction and distance from the assumed source should be reported. These identifiers are not coordinates, but a distance (in metres) to the source. They are given as relative locations. The horizontal distance identifier is PRA and the vertical distance identifier PRH. The bearing identifier is PRB with value in degrees (0 - 360), where a point north of the source is given as 0 or 360 degrees. A point east of the source is 90 degrees.

Q group of identifiers - source coordinates

The Q identifier is used to report source coordinates. Only the most common source types can be defined with coordinates. These are point sources, line sources, circular area sources, area sources with four edges and volume sources with four edges projected on the ground.

S group of identifiers - source description

For some applications it is necessary to describe the geometry of the source to correctly interpret measured results. This is especially the case for *in situ* measurements, where assumptions of the distribution of the source in the ground must be made. The identifiers for description of source geometry in ground starts with the letters SG and descriptions for source geometry in air starts with SA. Only a few generally used source types are defined. For ground sources they are point, line, plane, slab, uniform and exponential source distributions.

Sampled sources are described by the SS identifier, which can take on an number of additional characters, for example, SSI is the sample identification code and SSH is the sample description. Values for sample type and treatment can be given by using the corresponding EURDEP codes.

W group of identifiers - weather and environment

The W group identifies some weather phenomena that could influence the measured result. Identifiers are defined for precipitation rate, WPR, and snow cover depth, WPS. Mostly, the precipitation rate will be unknown. Precipitation can be identified by WP using the values Y for yes and N for no. For airborne measurements the air density will affect the results somewhat. The identifier WAD can be used to give the value of air density.

group of identifiers for pulse height distribution data

The NKS 1999 version had not any format for pulse height data such as count rates in channels. In the expanded format the number sign # is used together with the channel number as an identifier for spectral data. Data should be preceded by a declaration of data type and system identification using the #PHD(*sysid*) identifier.

Example:

/* Begin of pulse height data */

#PHD(1) "Counts in the 662 keV Cs-137 peak"

#C1001 123 #C1002 144 #C1003 189 #C1005 212 #C1006 315 #C1007 121
#C1008 89 #C1009 72 #C1010 55

The lines above give the counts in the channel numbers 1001 up to 1010. The identifier #PHD(1) tells that the following data is from the subsystem with identification number 1.

Because the format always must be based on identifier-value pairs it is not optimal for the reporting of pulse height distribution data since an identifier must precede each data value. However, the choice of the characters #C followed by the channel number still makes the format reasonably short when used for this purpose.

Sometimes only data for regions of interests are to be reported. The #ROI(*sysid*) identifier states that region of interest data follows. The identifiers #RC*number* and #RCR*number* are used for numbering regions of interest. The identifiers #EC*energy* and #ECR*energy* are used to state energy values of regions of interest.

& marker for additionally defined identifiers

Sometimes the original identifiers defined within the format are not enough to describe all data to be reported. The user can define additional identifiers. This is done by the identifier DEFINE&*identifier* where &*identifier* is the new identifier for the user. The value should describe the identifier and the unit. The definition should be written in the heading section. After defining the new identifier it can be used anywhere in the file.

Example:
DEFINE&DRCOSM "Cosmic dose rate, nSv/h"
Defines a new identifier &DRCOSM to be used anywhere in the file.

Example

This is an example of version 0.9 file

```
V 0.9   /* File version identifier */
/* The following lines describe heading information, instrumentation and method. It can be written anywhere, */
/* but it is recommended to put the heading information at the start of the file */
HORG SSI HMODE REAL HTEAM SEA HFILE EXAMPL
IAP(1) "GR660"  ICA(1) "Bell 412" IMF(1) "spectrometer in centre of helicopter"
IA1(2) "RNI10S" ICA(2) "Bell 412" IMF(2) "GM-probe outside on starboard side"
IA1(3) "RNI10S" ICA(3) "Bell 412" IMF(3) "data recalculated to 1 m above ground"
/* Source geometry description for Cs-137, slab source with 10 cm depth. These are estimated values */
SGSS_E_Cs-137 0 SGSP_E_Cs-137 0.1
/* Map datum should be given before position coordinates */
IPWGS84 "Garmin 12 XL"
/* Measured data, activity per unit area for Cs-137 */
N 1 CD 2002-03-15 CT 12:30:10 PN 63.13575 PE 13.65324 AA_Cs-137 3.5E+3 AA_UR_Cs-137 1E+3
N 2 CD 2002-03-15 CT 12:30:12 PN 63.13595 PE 13.65328 AA_Cs-137 3.6E+3 AA_UR_Cs-137 1E+3
N 3 CD 2002-03-15 CT 12:30:14 PN 63.13610 PE 13.65335 AA_Cs-137 3.7E+3 AA_UR_Cs-137 1E+3
N 4 CD 2002-03-15 CT 12:30:16 PN 63.13620 PE 13.65347 AA_Cs-137 3.6E+3 AA_UR_Cs-137 1E+3
N 5 CD 2002-03-15 CT 12:30:18 PN 63.13628 PE 13.65354 AA_Cs-137 3.9E+3 AA_UR_Cs-137 1E+3
N 6 CD 2002-03-15 CT 12:30:20 PN 63.13632 PE 13.65364 AA_Cs-137 3.8E+3 AA_UR_Cs-137 1E+3
/* Some pulse height distribution data for the 6:th measurement */
#PHD(1) "MCA channel 1000 - 1016 Cs-137 peak, live time 10 s"
N 6 #C1000 129 #C1001 133 #C1002 145 #C1003 301 #C1004 670 #C1005 912
N 6 #C1006 998 #C1007 733 #C1008 528 #C1003 345 #C1009 252 #C1010 149
N 6 #C1011 129 #C1012 133 #C1013 128 #C1014 125 #C1015 112 #C1016 109
/* Position and apparent activity of an identified point source of Co-60 */
CD 2002-03-15 CT 12:50:20 QCPN_Co-60 63.13769 QCPE_Co-60 13.53892 AP_A_Co-60 7.4E+09
/* Kerma rate for the identified point source at 10 m distance east of the source */
CT 12:50:20 QCPN_Co-60 63.13769 QCPE_Co-60 13.53892 PRA_Co-60 10 PRB_Co-60 90 DK_Co-60 0.7
```

Identifiers for the multiple-paired radiation data format

Header identifiers[1]

Should be placed in records at the beginning of the file

V	**File format version**	**Value format**
V	Format version. The value for this version is 0.9	Text

H	**General heading information**	**Value format**
HCTRY	Country	Text
HORG	Organisation	Text
HMODE	Operational mode. Values are REAL, EXERCISE or TRAINING	Text
HTEAM	Team	Text
HSITE	Site	Text
HFILE	File name or other code	Text

IA(*sysid*)	**Instrumentation, apparatus** ***sysid*** - system identification is optional. The third character in the code for instrumentation is the same as the EURDEP code for apparatus type. Common types are given here. Value should describe the apparatus.	**Value format**
IAB	Alpha - ZnS scintillator	Text
IAD	Alpha - solid state detector	Text
IAY	Alpha - alpha spectrometry	Text
IAE	Alpha - other	Text
IAG	Beta - Geiger-Müller counter	Text
IAJ	Beta - solid state detector	Text
IAK	Beta - other	Text
IAM	Beta and gamma - other	Text
IA1	Gamma - Geiger-Müller tube	Text
IAN	Gamma - TLD	Text
IAO	Gamma - ionisation chamber	Text
IAP	Gamma - sodium iodide detector	Text
IAU	Gamma - gamma spectrometry scintillator	Text
IAQ	Gamma - solid state detector, Ge(Li) och HPGe	Text
IAR	Gamma - other	Text
IAZ	Other	Text

IC(*sysid*)	**Instrumentation, carrier or platform** ***sysid*** - system identification is optional. Value should describe the carrier.	**Value format**
ICA	Airborne	Text
ICF	Fixed	Text
ICG	Ground vehicle	Text
ICI	In situ	Text
ICL	Laboratory	Text
ICP	Portable	Text
ICZ	Other	Text

IM(*sysid*)	**Instrumentation, method** ***sysid*** - system identification is optional. Value should describe the method.	**Value format**
IM4	4π-geometry	Text
IMC	With collimator	Text
IMS	With shield	Text
IMT	Cosmic reduction	Text
IMZ	Other	Text

IP(*sysid*)	**Instrumentation, positioning** ***sysid*** - system identification is optional Value should describe the instrument for positioning.	**Value format**
IPWGS84	World Geodetic System 1984, degrees.decimals	Text
IPRT90	Swedish grid RT 90	Text
IPBNG	British National Grid, BNG	Text

&	**Additionally defined identifiers** Value should describe the identifier and the unit.	**Value format**
DEFINE&*idf*	Define additional identifier. The identifier is &*idf*. This definition must occur before the identifier can be used. Example: DEFINE&DRCOSM "Cosmic dose rate, nSv/h" defines a new identifier &DRCOSM	Text
&*idf*	An additional identifier &*idf* that can be used anywhere in the file.	Unit as defined by DEFINE

1. Identifier-value pairs of the header type, should be placed in the beginning of the file. For readability, the comment marker should mark the start and end of the heading section, for example:
/* Start of heading section */
Identifier-value pairs
/* End of heading section */

Quoted values and comment marks

Can be placed anywhere in the file

	Quotes and comments	Format
"	**Values** that include spaces must be enclosed within the double quote character. Example "This is a valid value"	Text
/*	**Start of comment mark**. There will not be any decoding of values between start of comment and end of comment markers. Comments cannot automatically continue to new lines. A comment on a new line must be preceded by the start of comment mark.	Text
*/	**End of comment mark**.	Text

Weather and environment identifiers

Can be placed anywhere in the file, but preferably in the header

W	**Weather**	**Value unit**
WP	Precipitation yes or no. Values are Y or N	Text
WPR	Precipitation rate	mm/h
WPS	Snow cover depth	m
WAT	Air temperature	oC
WAH	Air humidity	%
WAD	Air density	kg/m^3
WGD	Ground density	kg/m^3
WGH	Ground moisture content, wet weight /dry weight	Numeric

Measurement data identifiers

Can be placed anywhere in the file after the heading

C	**Calendar date[2] and time[2]**	**Value format**
CD	Measurement date (YYYY-MM-DD) Example: 2002-04-28	ISO8601
CT	Measurement time of day (hh:mm:ss) Example: 13:35:12 13:35:12Z 14:35:12+01	ISO8601
CDR	Reference date	ISO8601
CTR	Reference time	ISO8601
CDS	Measurement date start	ISO8601
CTS	Measurement time start	ISO8601
CDP	Measurement date stop	ISO8601
CTP	Measurement time stop	ISO8601
CDM	Measurement date middle	ISO8601
CTM	Measurement time middle	ISO8601
CDSS	Sampling date start	ISO8601
CTSS	Sampling time start	ISO8601
CDSP	Sampling date stop	ISO8601
CTSP	Sampling time stop	ISO8601
CDSM	Sampling date middle	ISO8601
CTSM	Sampling time middle	ISO8601

2. The letter Z following the date and time indicates Universal Time, UTC. Adding the string +hh or – hh to the time of day, where hh is the time difference relative to UTC, indicates local time.

Example: 12:00 UTC is written 12:00Z. Central European Time, CET, is 1 hour ahead of UTC. At 12:00Z, the CET during winter will be 13:00+01 and during summer - when daylight saving time - 14:00+02.

A(*sysid*)	**Activity** ***sysid* -** system identification is optional.	**Value unit**
AP	Activity of a point source	Bq
AL	Activity per unit length of a source distributed along a line	Bq/m
AA	Activity per unit area of source distributed over an area	Bq/m2
AV	Activity per unit volume of a source distributed in a volume	Bq/m3
AD	Activity per unit dry weight of a source distributed in a volume	Bq/kg
AW	Activity per unit wet weight of a source distributed in a volume	Bq/kg
AE	Activity per unit area as equivalent surface deposition (1 m above ground)	Bq/m2
AF	Activity per unit area as equivalent surface activity (at the measurement height)	Bq/m2

D(*sysid*)	**Dose and dose rate** ***sysid*** - system identification is optional.	**Value unit**
DA	Dose to air in free air	µGy
DAR	Dose rate to air in free air	µGy/h
DK	Air kerma in free air	µGy
DKR	Air kerma rate in free air	µGy/s
DX	Exposure	µR
DXR	Exposure rate	µR/s
DHS	Ambient dose equivalent H*(10)	µSv
DHSR	Ambient dose equivalent rate H*(10)	µSv/s
DHI	Directional dose equivalent H'	µSv
DHIR	Directional dose equivalent rate H'	µSv/s
DHP	Personal dose equivalent Hp (ICRU 1993)	µSv
DHPR	Personal dose equivalent rate Hp	µSv/s
DE	Effective dose (not measurable quantities)	µSv
DER	Effective dose rate	µSv/s
DEAP	Effective dose AP geometry	µSv
DEAPR	Effective dose rate AP geometry	µSv/s
DEPA	Effective dose PA geometry	µSv
DEPAR	Effective dose rate PA geometry	µSv/s
DELA	Effective dose LAT geometry	µSv
DELAR	Effective dose rate LAT geometry	µSv/s
DELL	Effective dose LLAT geometry	µSv
DELLR	Effective dose rate LLAT geometry	µSv/s
DERL	Effective dose RLAT geometry	µSv
DERLR	Effective dose rate RLAT geometry	µSv/s
DERO	Effective dose ROT geometry	µSv
DEROR	Effective dose rate ROT geometry	µSv/s
DEIS	Effective dose ISO geometry	µSv
DEISR	Effective dose rate ISO geometry	µSv/s

F(*sysid*)	**Fluence** ***sysid*** - system identification is optional.	**Value unit**
F	Fluence	/m2
FR	Fluence rate	/m2·s

T(*sysid*)	**Acquisition time** ***sysid*** - system identification is optional.	**Value unit**
TL	Acquisition live time	s
TR	Acquisition real time	s

N	**Numbering**	**Value format**
N	Record number or measurement number	Number or text

P	**Location, geographic coordinates** The coordinate system (map datum) is defined by the IP identifier that should be given before measured data.	**Value format or unit**
PA	Name or code for the measurement or sample point	Text
PB	Additional description of the measurement or sample point	Text
PN	Measurement or sample point coordinate N-S (latitude) Negative values allowed, when appropriate.	Numeric
PE	Measurement or sample point coordinate E-W (longitude) Negative values allowed, when appropriate.	Numeric
PZ	Measurement or sample point, altitude above sea level	m
PH	Measurement or sample point, ground clearance	m

PR	**Relative location related to the source**	**Unit**
PRA	Relative position of measurement or sample point, horizontal distance to centre of source	m
PRH	Relative position of measurement or sample point, height above the centre of a source, negative values allowed	m
PRB	Direction (bearing) of the measurement or sample point relative to the North direction (0-360 degrees). Example: A measurement point North of the source is 0 degrees. A measurement point East of the source is 90 degrees.	degrees

#	**Raw data**	**Value format or unit**
#PHD(*sysid*)	Pulse height distribution data from spectrometer follows. *sysid* - system identification is optional. Value should give some description of what has been measured and selected .	Text
#C*number*	Counts in channel *number*	Numeric
#CR*number*	Count rate in channel *number*	/s
#ROI(*sysid*)	Region of interest data from spectrometer follows. *sysid* - system identification is optional. Value should give some description of what has been measured and selected.	Text
#RC*number*	Counts in region of interest *number*	Numeric
#RCR*number*	Count rate in region of interest *number*	/s
#EC*energy*	Counts for *energy* in keV. Example #EC662	Numeric
#ECR*energy*	Count rate for *energy* keV. Example #ER352	/s
#EC*energy1-energy2*	Count between *energy1* and *energy2*. Energy in keV Example #EC640-680	Numeric
#ECR*energy1-energy2*	Count rate between *energy1* and *energy2*. Energy in keV Example #EC640-680	/s

Source description identifiers

Should be placed together with measurement data

SG	**Source geometry in ground, general description** Description of the source geometry in ground without specification of source coordinates. Can be combined with the Q-identifier to specify geographical coordinates. The identifier can take on a radionuclide tail.	**Value unit**
SGP	Point source in ground at depth	m
SGL	Line source in ground at depth	m
SGA	Plane source in ground at depth	m
SGSS	Slab source in ground, start at depth	m
SGSP	Slab source in ground, stop at depth	m
SGV	Uniform source in ground start at depth	m
SGE0	Exponential source in ground, coefficient at air ground interface or zero ground clearance height	m
SGEM	Exponential source, exponent coefficient (mass depth)	m^2/kg
SGEL	Exponential source, exponent coefficient (linear depth)	/m

SA	**Source geometry in air, general description** Description of the source geometry in air without specification of source coordinates. Applicable for airborne, mobile, carried and *in situ* measurements. Can be combined with the Q-identifier to specify geographical coordinates. The identifier can take on a radionuclide tail.	**Value unit**
SAP	Point source in air at ground clearance height.	m
SAL	Line source in air at ground clearance height.	m
SASS	Uniform slab source in air, start at ground clearance.	m
SASP	Uniform slab source in air, stop at ground clearance.	m
SAV	Uniform source in air start at ground clearance, infinite height.	m
SACHH	Cylindrical source in air, horizontal axis, centre at ground clearance height.	m
SACHR	Cylindrical source in air, horizontal axis, radius.	m
SACV	Cylindrical source in air, vertical axis, start at ground clearance height, infinite height.	
SACVS	Cylindrical source in air, vertical axis, start at ground clearance height.	m
SACVP	Cylindrical source in air, vertical axis, stop at ground clearance height.	m
SACVR	Cylindrical source in air, vertical axis, radius.	m
SAE0	Exponential source in air at zero ground clearance.	m
SAEM	Exponential coefficient (mass height)	m^2/kg
SAEL	Exponential coefficient (linear height)	/m

SS	**Source sample description** Specific description of sampled sources. Coordinates for source samples should be given with the P identifier.	**Value format or unit**
SSI	Sample identification code	Text
SSH	Sample description	Text
SSTYPE	Sample type code where the value is the 1 - 4 letter EURDEP sample type code. For example: A1 air sample — A11 outdoor air A2 water sample — A21 surface water A3 soil sample — A212 lake water A4 deposition — A23 waste water A5 external radiation — A32 soil + grass A6 sediment — A33 *in situ* A44 aerial gamma — A411 total deposition A422 snow melt water — A421 rain water AZ environmental sample — A43 grass	Text code
SSTREA	Sample treatment code where the value is the one letter EURDEP sample treatment code. For example: A unspecific — K deep frozen B no treatment — M liquid reduced to is residue E measured immediately — V Sample washed I radiochemical separation — W evaporation + ashing L oven dried — X dried + homogenised Q homogenization — Y mixed U air dried — Z others	Text code
SSVALU	Sample value type code where the value is the one letter EURDEP value code. For example: A discrete single meas. — G highest value B bulked sample average — O lowest value C time average — H time average month D geograph average — L time average year F time and geograph aver. — Z not specified J discrete sample from bulked source	Text code
SSV	Sample volume	m^3
SSY	Sample density	kg/m^3
SSW	Sample wet weight	kg
SSD	Sample dry weight	kg
SSA	Sample area	m^2
SSS	Sample depth start	m
SSP	Sample depth stop	m
SSL	Sample linear depth thickness	m
SSM	Sample mass depth thickness	m^2/kg

Source coordinate identifiers

Should be placed together with measurement data

Q	**Location of a source in the environment.** The coordinate system (map datum) is defined by the IP identifier that should be given before measurement data. The identifier can take on a radionuclide tail.	**Value format or unit**
QA	Name or code for the source	Text
QB	Additional description of the source	Text
QCPN	Point source coordinate N-S (latitude)	Numeric
QCPE	Point source coordinate E-W (longitude)	Numeric
QCPZ	Point source, altitude above sea level	m
QCPH	Point source, ground clearance	m
QCLN1	Line source first coordinate N-S	Numeric
QCLE1	Line source first coordinate E-W	Numeric
QCLN2	Line source first coordinate N-S	Numeric
QCLE2	Line source first coordinate E-W	Numeric
QCLZ	Line source, average altitude above sea level	m
QCLH	Line source, average ground clearance	m
QCCN	Circular source centre coordinate N-S	Numeric
QCCE	Circular source centre coordinate E-W	Numeric
QCCR	Circular source radius	m
QCCZ	Circular source, average altitude above sea level	m
QCCH	Circular source, average ground clearance	m
QCAN1	Area source coordinate N1	Numeric
QCAE1	Area source coordinate E1	Numeric
QCAN2	Area source coordinate N2	Numeric
QCAE2	Area source coordinate E2	Numeric
QCAN3	Area source coordinate N3	Numeric
QCAE3	Area source coordinate E3	Numeric
QCAN4	Area source coordinate N4	Numeric
QCAE4	Area source coordinate E4	Numeric
QCAZ	Area source, average altitude above sea level	m
QCAH	Area source, average ground clearance	m
QCVN1	Volume source coordinate N1	Numeric
QCVE1	Volume source coordinate E1	Numeric
QCVN2	Volume source coordinate N2	Numeric
QCVE2	Volume source coordinate E2	Numeric
QCVN3	Volume source coordinate N3	Numeric
QCVE3	Volume source coordinate E3	Numeric
QCVN4	Volume source coordinate N4	Numeric
QCVE4	Volume source coordinate E4	Numeric
QCVZ1	Volume source, start at average altitude above sea level	m
QCVZ2	Volume source, stop at average altitude above sea level	m
QCVH1	Volume source, start at average ground clearance	m
QCVH2	Volume source, stop at average ground clearance	m

Identifier tails

Should be connected to the body of certain identifiers

	Identifier tail Type 1: Detection limit, uncertainty, apparent and estimated values. Can be used for activity, dose, dose rate, fluence and fluence rate. Should be written before identifier tail Type 2.	**Value unit**
_LC	Decision limit Example: Decision limit for activity per unit area: AA_LC	*
_LD	Detection limit	*
_LQ	Determination limit	*
_UR	Random uncertainty	*
_US	Systematic uncertainty	*
_UT	Combined total uncertainty	*
_URP	Random uncertainty percent	%
_USP	Systematic uncertainty percent	%
_UTP	Combined total uncertainty percent	%
_UE*x*	Error type where *x* is the EURDEP-code for denoting error type using the letters A – Z. Example: _UEA standard deviation _UED standard error of the mean	**
_A	Apparent value assuming a specific source geometry that probably is not the correct geometry. Applicable for reporting activity when the source geometry is unknown.	*
_G	Estimated or guessed value, not a measured value. Applicable for a source in the environment that has not yet been thoroughly quantified.	*

	Identifier tail Type 2: Radionuclide, energy Can be used for activity, dose, dose rate, fluence, fluence rate, source descriptions and source coordinates.	**Value unit**
_*Xx-000m*	Radionuclide. All radionuclides allowed. Examples: _Cs-137, _Tc-99m Decision limit for Cs-137 per unit area: AA_LC_Cs-137	*
_TOT	Total for all radionuclides	*
_NAT	Natural radionuclides	*
_ANT	Antropogenic radionuclides	*
_COS	Cosmic	*
_E*energy*	*Energy* (given in keV). Example: _E662	*

* The unit should be the same as for the body of the identifier
** The unit depends on the definition of the quantity related to the EURDEP error code

Bibliographic Data Sheet **NKS-86**

Title	ECCOMAGS: Initial results from the RESUME 2002 exercise
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Abstract	In the RESUME 2002 exercise (Rapid Environmental Surveying Using Mobile Equipment) areas in SW Scotland were surveyed for anthropogenic and natural radioactivity with Airborne Gamma Spectrometry (AGS), Car-borne Gamma Spectrometry (CGS) and in-situ measurements. Results from the exercise are presented, including composite maps and data produced at the exercise, and initial results from the post-exercise data analysis. A format for processed data exchange developed for the exercise is presented. The final data analysis will include comparisons within airborne and between airborne and ground based measurements
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